Newton's Laws of Motion

Newton's Laws of Motion

- **<u>1st Law:</u> An object in motion tends to stay in motion and an object at rest tends to stay at rest unless acted upon by an unbalanced force.**
- **<u>2nd Law:</u> Force equals mass times acceleration (F = ma).**
- **<u>3rd Law:</u> For every action there is an equal and opposite reaction.**

Newton's First Law

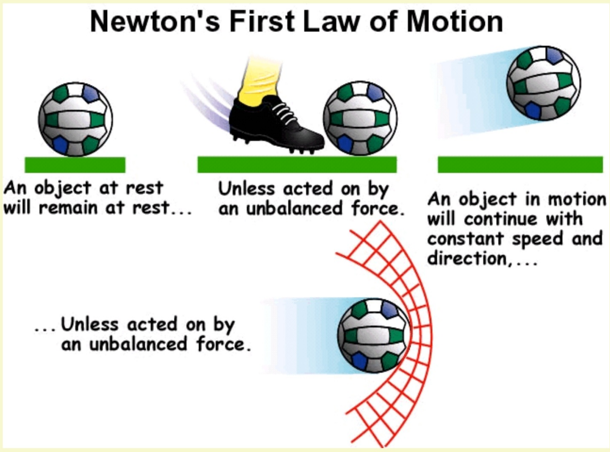
An object at rest tends to stay at rest and an object in motion tends to stay in motion unless acted upon by an unbalanced force.

What does this mean?

Basically, an object will "keep doing what it was doing" unless acted on by an unbalanced force.

If the object was sitting still, it will *remain stationary*. If it was moving at a constant velocity, it will *keep moving*.

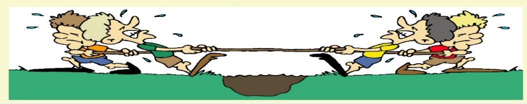
It takes *force* to change the motion of an object.



Some Examples from Real Life of Law #1

A soccer ball is sitting at rest. It takes the force of a kick to change its motion.

Two teams are playing tug of war. They are both exerting equal force on the rope in opposite directions. This balanced force results in no change of motion.



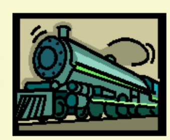
Newton's First Law is also called the *Law of Inertia*

<u>Inertia</u>: the tendency of an object to resist changes in its state of motion

The First Law states that *all objects have inertia*. The more mass an object has, the more inertia it has (and the harder it is to change its motion).

More Examples of Law #1 from Real Life

A powerful locomotive begins to pull a long line of boxcars that were sitting at rest. Since the boxcars are so massive, they have a great deal of inertia and it takes a large force to change their motion. Once they are moving, it takes a large force to stop them.



On your way to school, a bug flies into your windshield. Since the bug is so small, it has very little inertia and exerts a very small force on your car (so small that you don't even feel it).

If objects in motion tend to stay in motion, why don't moving objects keep moving forever?

Things don't keep moving forever because there's almost always an unbalanced force acting upon it.

A book sliding across a table slows down and stops because of the force of

If you throw a ball upwards it will eventually slow down and fall because of the force of

In outer space, away from gravity and any sources of friction, a rocket ship launched with a certain speed and direction would *keep going in that same direction and at that same speed forever*.

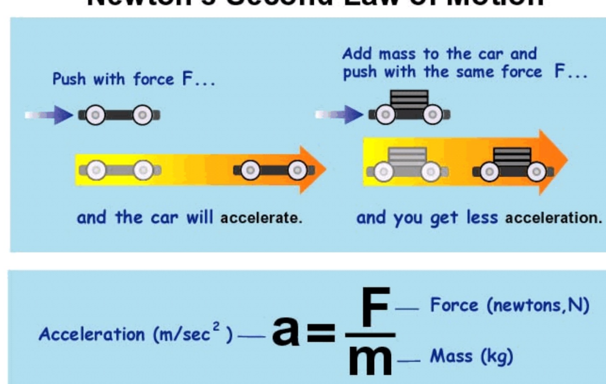
Newton's Second Law

Force equals mass times acceleration.

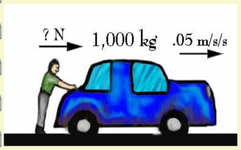
F = ma

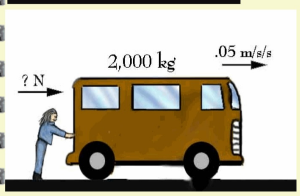
<u>Acceleration</u>: a measurement of how quickly an object is changing speed.

Newton's Second Law of Motion



Everyone knows that heavier objects require more force to move the same distance than lighter objects. However, the 2nd Law gives us an exact relationship between force, mass, and acceleration.





Which car will be harder to move?

Real Life examples of Law #2

F = ma basically means that the force of an object comes from its mass and its acceleration.

Something very massive (high mass) that's changing speed very slowly (low acceleration), like a glacier, can still have great force.

Something very small (low mass) that's changing speed very quickly (high acceleration), like a bullet, can still have a great force. Something very small changing speed very slowly will have a very weak force.

Newton's Third Law

For every action there is an equal and opposite reaction.

What does this mean?

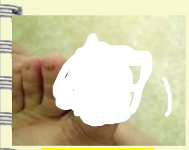
For every force acting on an object, there is an equal force acting in the opposite direction. Right now, gravity is pulling you *down* in your seat, but Newton's Third Law says your seat is pushing *up* against you with *equal force*. This is why you are not moving. There is a *balanced force* acting on you– gravity pulling down, your seat pushing up.

Newton's Third Law of Motion

For every action force, there is a reaction force equal in strength and opposite in direction.

Think about it . . .

What happens if you are standing on a skateboard or a slippery floor and push against a wall? **You slide away from the wall, because you pushed on the wall but the wall pushed back on you with equal and opposite force.**



Erase the toe if you dare

Why does it hurt so much when you stub your toe? **When your toe exerts a force on a rock, the rock exerts an equal force back on your toe. The harder you hit your toe against it, the more force the rock exerts back on your toe.**

Review

Newton's First Law:

Newton's Second Law:

Newton's Third Law:

Match Up the Laws (11 items)

Newton's 1st Law	Newton's 2nd Law	Newton's 3rd Law